REMARKS

Summary of Personal Interview With the Examiner

On October 24, 2005, Examiner Irina Zemel and the Applicants' representative, Andrew Merriam, conducted a personal interview to further prosecution in the instant application. The Applicants wish to thank Examiner Zemel for extending the courtesy of a personal interview.

During the interview, the parties discussed the various art rejections and the restriction requirement.

Mr. Merriam explained the instantly recited invention, wherein the thermoplastic binder acts along with the instantly recited phosphorus containing material as an intumescent mixture. Thus, the instantly recited intumescent composition has no separate blowing agent or carbonific and exhibits excellent film forming properties. See, for example, the instant specification at page 4, last 2 paragraphs, and page 3, lines 4-10.

Mr. Merriam distinguished the art of Hoechst, JP 8-283621A, of record, and its combination with each of the BASF Technical Information Bulletin for Laropal™ A-81 and A-101 (BASF), of record, from the instant claims, as follows:

Hoechst fails to disclose, teach or suggest the instantly recited proportion of thermosetting binder. See, for example, the official translation of Hoechst, copy enclosed, at page Abstract, paragraph 2, and paragraph [0007] on page 5. Further, the ranges taught in Hoechst are exhaustive and are not exemplary; thus, the teachings of Hoechst fail to motivate the ordinary skilled artisan to modify the ranges of resin taught therein. *Ibid.*

BASF, as Mr. Merriam pointed out, also fails to suggest any reason to add a BASF resin to Hoechst or to otherwise modify the resin proportions of Hoechst so that the combination meets the instantly recited proportion of thermosetting binder. Hoechst and BASF teach away from each other regarding resin hardness. Contrast BASF at "Application", page 2, 2nd para., and the reference in the official translation of Hoechst at p.10, para. [0023]; see also MPEP 2145.X.D. In addition, BASF fails to provide any expectation of success in improving the

solids content of Hoechst. See BASF at "Application", page 2, 3[d] para., and see Hoechst at Working Examples 1 and 3, p.13 concerning solids content.

Mr. Merriam also explained that even if a thermoplastic binder, as instantly recited, could properly be added to Hoechst, *which it cannot*, the instantly recited binder is reactive with the instantly recited phosphorus containing material. Thus, the thermoplastic binder used to modify Hoechst would have to comprise part of the flameproofing component in Hoechst, so that the amount of such a binder would still have to fall within the range of proportions of the flameproof mixture taught in Hoechst. That is, for Hoechst to be operative, the proportions of each of epoxy resin component and the flameproofing component, including any thermoplastic binder, would have to be maintained relative on another. Accordingly, the proportion of epoxy resin component in Hoechst even if modified by BASF would still fall outside the instantly recited range.

Regarding the restriction requirement, Mr. Merriam pointed out that unrelated inventions are truly rare and are inapposite to the instant case. To show that inventions are unrelated, the restriction has to show, among other things, that they are not disclosed as capable of use together. See MPEP 8.20.02. However, please see the instant specification at page 2, lines 1-10, showing that intumescent coatings are most often applied in multiple layers and may require significant reinstatement work. Because powder coatings cannot be applied in the field, reinstatement work comprises coating with a liquid. Accordingly, powder intumescent coatings and liquid reinstatement coatings are in fact disclosed as useful together. In addition, Mr. Merriam has drafted a claim linking the species of coating compositions instantly claimed to insure that the instant claims are at least examined via an election of species. See MPEP 809.

No agreement was reached regarding the rejection.

The Examiner requested entry of the official translation of Hoechst on the record by Applicants.

The Examiner graciously agreed to consider the remarks in this response and indicated her willingness to speak again with Mr. Merriam by telephone to further prosecution in the instant application.

Support for the Amendments to the Claims

The amendment to instant claim 1 seeks solely to better define the instant invention by incorporating the substance of claim 14 into claim 1 and sets forth all of the species of the instantly recited compositions in a single generic claim. In addition, the amendment to claim 1 corrects an obvious typographical error and sets forth the correct amount of phosphorus containing material. Support for this amendment may be found, for example, in the instant specification at page 1, 2nd to last line to page 2, line 1, page 6, lines 16-20 and at page 3, lines 12-13.

Claims 15 and 16 have been canceled. The total number of claims has been reduced by 2.

Upon entry of the present amendment, claims 1-6, 8-14 and 17-18 will stand pending in the instant application. No new matter has been added by the present amendment.

Restriction Requirement

The unrelated inventions restriction is improper because the restriction has failed to show that the "inventions", of which there is only one, are not disclosed as capable of use together. See the Summary Of Personal Interview With The Examiner, at page 6, above. Further, each of the "inventions" relate to the same design (compositions of the same ingredients), modes of operation (coating by known means, including electrostatic spray for each of powder and liquid), and effect (intumescent on heating).

Applicants respectfully request the reconsideration and withdrawal of the restriction requirement and, instead, a species election by original presentation.

Rejections Under 35 USC §103(a)

Claims 1-6 and 8-13 stand rejected under 35 USC section 103(a) as being obvious over Hoechst AG, JP 8-283621A (Hoechst), of record, in view of each of the BASF Technical Information Bulletin for Laropal™ A-81 and Laropal™ A-101 (BASF), of record. The Applicants respectfully traverse these rejections.

As the rejection admits, Hoechst fails to provide thermoplastic resins that react with phosphoric acid, as is instantly recited. Further, Hoechst fails to teach any oxygenated heterocyclic thermoplastic resin, as instantly recited. In addition, BASF fails to teach any intumescent composition, as instantly recited, any thermosetting resin, as instantly recited, or any resin proportions, as instantly recited.

Further, none of the references provide the instantly recited proportion of thermosetting resin binder. As each feature of the instant claims is not met by the combination of Hoechst and BASF, the rejection is improper. See MPEP 2143.03.

Even if there were some suggestion in Hoechst and BASF of all features in the instant claims, *which there is not*, there is no suggestion anywhere in Hoechst or BASF of a proper reason to combine the references. See the Summary Of Personal Interview With The Examiner, at pages 5-6, above, regarding hardness and solids content.

Most important, in any case the combination of Hoechst and BASF fails to meet the instant claims without impermissibly rendering the Hoechst teachings inoperative. It is well settled that any proposed modification of Hoechst that would render it unsatisfactory for its intended purpose amounts to no suggestion or motivation to make the proposed modification. *In re Gordon*, 733 F.2d 900, 221 USPQ 1125 (Fed. Cir. 1984). In the instant case, the binder which the rejection seeks to combine with Hoechst is reactive and would be part of the flameproof mixture of Hoechst. See the Summary Of Personal Interview With The Examiner, at page 6, paragraph 1, above. Accordingly, the combination in the rejection would have one increase the proportion of the flameproof mixture in Hoechst contrary to the teachings of Hoechst and to an unsuitable level in the

composition of Hoechst. *Ibid.* Thus, the combination of Hoechst and BASF to meet the instant claims is improper. See *also* MPEP 2143.01 re: "Cannot Render the ...Art Unsatisfactory for its Intended Purpose."

For all of these reasons, the Applicants respectfully request the reconsideration and the withdrawal of all rejections.

Please be advised that each of Hoechst and BASF fails to disclose, teach or suggest powder coatings or aqueous coatings; thus, each is further removed from the non-elected species than it is from the elected species.

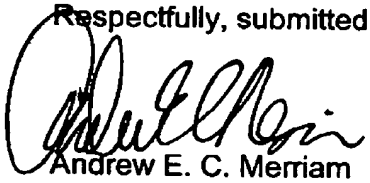
CONCLUSION

Based on the foregoing, the instant claims are believed to be in current condition for allowance. An early and favorable response is earnestly solicited. If the examiner has any questions problems concerning the instant application, (s)he is urged to contact the undersigned at the number given below.

Enclosed herewith, Applicants submit a copy of the official translation of Hoechst reference, JP 8-283621A, of record

No fees are believed due. In the event that any fees are found owing, please charge deposit account no. 18-1850.

Respectfully, submitted



Andrew E. C. Merriam
Attorney for Applicants
Registration No. 47,268
Telephone (215) 592-6758

Rohm and Haas Company
100 Independence Mall West
Philadelphia, PA 19106

Enclosure official translation of JP 8-283621A (15 pp.)

TRANSLATED FROM JAPANESE BY ACCURAPID – THE LANGUAGE SERVICE

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(71) Applicant: 590000145
Hoechst Aktiengesellschaft
Frankfurt-am-Main 65926, German Federal Republic
(72) Inventor(s): Elke Jenewein
15 Maienstrasse, Gersthofen, German Federal Republic
Wolf-Dieter Pirig
17 Kastanienweg, Euskirchen, German Federal Republic
(74) Agent: Mitsushi Ezaki, Patent Attorney (and 3 others)

(54) Title of Invention: Flameproof coating

(57) Abstract:
Problem to be Solved: To develop a flameproof foam coating which does not contain halogens, which has a high flame retardancy, which can be produced simply and inexpensively, and which is simple to use.

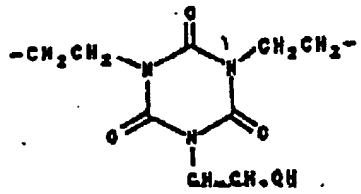
Solution to the Problem: A flameproof foam coating comprising 40–90% by weight epoxy resin, 10–60% by weight flameproof mixture containing an aromatic carboxylic acid ester of tris(2-hydroxyethyl) isocyanurate as a synergist together with a polymeric ammonium polyphosphate, as well as other additives, as needed.

Claims:

(1) A flameproof foam coating containing no halogens, comprising 40–90% by weight (preferably 60–70% by weight) epoxy resin, 10–60% by weight (preferably 30–40% by weight) flameproof mixture containing an aromatic carboxylic acid ester of tris(2-hydroxyethyl) isocyanurate as a synergist together with a polymeric ammonium polyphosphate, as well as other additives, as needed.

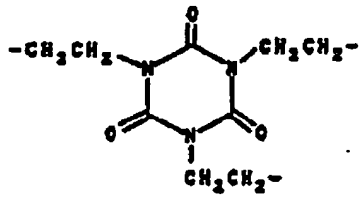
(2) A flameproof foam coating containing no halogens in accordance with Claim (1), in which the flameproof mixture comprises 50–80% by weight ammonium polyphosphate, shown by the formula $(NH_4PO_3)_n$ (where n is a number in the range of 200–1000) (= Ingredient A) and 20–50% by weight of a compound consisting of a)–c) below (=Ingredient B):

a) 40–66 mol% of units shown by formula (I) below:



(I).

b) 0–10 mol% of units shown by formula (II) below:



(II)

and c) 24–66 mol% of units shown by formula (III):

$Ar(COO^-)^{m=}{}_m$ (III)

(wherein Ar is a mononuclear, binuclear, or trinuclear aromatic six-member ring and m is 2, 3, or 4), and in some cases the ammonium polyphosphate (flameproof Ingredient A) is coated with a coating composition at a weight up to 0.5–25% by weight.

(3) A flameproof foam coating containing no halogens in accordance with Claim (1) or Claim (2), in which the epoxy resin consists of an epoxy resin ingredient, such as bisphenol A, bisphenol F, or a mixture thereof, and a curing ingredient, preferably an aliphatic amine.

(4) A method for producing a flameproof foam coating containing no halogens, containing an epoxy resin and a flameproof mixture containing an aromatic carboxylic acid ester of tris(2-hydroxyethyl) isocyanurate as a synergist together with a polymeric ammonium polyphosphate; in said method, the epoxy resin ingredient is reacted with the flameproof mixture, after which this product is converted to a coating using a curing ingredient.

(5) A method of using a flameproof foam coating containing no halogens in accordance with any of Claims (1)–(3), or one produced by the method of Claim (4), in order to produce films or to coat floors, walls, or molded articles.

Detailed Description of the Invention:

[0001]

Technical Field of the Invention

This invention concerns novel foam coatings which do not contain halogens, a method of producing them, and a method of using them. These novel coatings are not only flame retardant but also have the property of very good workability.

[0002]

Related Art

At present, epoxy resins are used in a wide range of applications in producing epoxy resin molding materials and producing films with high levels of thermal, mechanical, and electrical properties, as well as laminated articles, etc. Various starting ingredients (epoxy resin ingredients) can be changed to high-quality materials by using curing agents (curing ingredients), such as carboxylic anhydrides, amines, phenols, or isocyanates, or by ionic polymerization. Since epoxy resins are low-molecular-weight [compounds] or oligomers in their initial states and have low viscosities at ordinary working temperatures, epoxy resins can generally be easily

handled. As a result, epoxy resins can be easily poured and molded, and can be used in saturation and impregnation processes.

[0003]

In the fields in which epoxy resins are needed (e.g., coatings for floor painting in filling station platforms, parking lots, airports, etc.), it is necessary to make the coatings flame retardant. Therefore, the epoxy resins and epoxy resin molding materials used in these applications must be self-flame retardant and have the property of not promoting flames.

[0004]

At present, flame retardant properties are provided to epoxy resin and epoxy resin molding materials by making them contain halogens, in particular, bromine-containing aromatic ingredients. Such ingredients often contain ammonium trioxide as a synergist, and are mixed with epoxy resins. For example, in the Specifications of European Patent Application 0 142 074, a flame retardant foam composition is described which contains primarily epoxy resins, phosphorus compounds, zinc compounds, or boron compounds; this composition decomposes when heated to high temperatures and releases inorganic and organic products which present multiple environmental and toxic dangers.

[0005]

Therefore, there is a high demand for epoxy resins in the form of coatings which have high flame retardancy but do not contain halogen ingredients or other substances which should be avoided because of environmental or toxicity reasons.

[0006]

Problems To Be Solved by the Invention

Therefore, the problem of this invention is to develop a flameproof foam coating which does not contain halogens, which has a high flame retardancy, which can be produced simply and inexpensively, and which is simple to use.

[0007]

Solution to These Problems

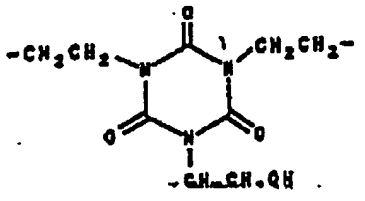
Consequently, this invention provides a flameproof foam coating comprising a mixture of 40–90% by weight epoxy resin, 10–60% by weight flameproof mixture containing an aromatic carboxylic acid ester of tris(2-hydroxyethyl) isocyanurate as a synergist together with a polymeric ammonium polyphosphate, as well as other additives, as needed.

[0008]

This kind of flameproof mixture is described in the Specifications of European Patent Application 0 584 567. According to these Specifications, the flameproof mixture comprises 50–80% by weight ammonium polyphosphate, shown by the formula $(NH_4PO_3)_n$ (where n is a number in the range of 200–1000) (= Ingredient A) and 20–50% by weight of a compound consisting of a)–c) below (=Ingredient B):

a) 40–66 mol% units shown by formula (I) below:

[0009]

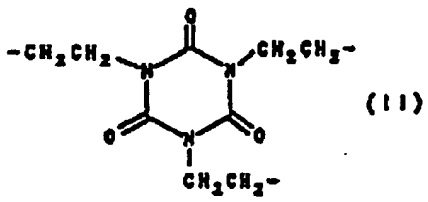


(I).

[0010]

b) 0–10 mol% units shown by formula (II) below:

[0011]



(II)

and

[0012]

c) 24–66 mol% units shown by formula (III):

$$Ar(COO^-)^{m=}{}_m$$

(wherein Ar is a mononuclear, binuclear, or trinuclear aromatic six-member ring and m is 2, 3, or 4).

[0013]

The epoxy compound containing no halogens used in this invention (also referred to below as "polyepoxide compound") may be saturated or unsaturated, and it can belong to the aliphatic, alicyclic, aromatic, and/or heterocyclic groups. Furthermore, these compounds may contain substituents which do not produce harmful side reactions under the mixing or reaction conditions; these include, for example, alkyl or aryl substituents, ether groups, etc. Mixtures of various polyepoxide compounds can also be used. The mean molecular weight M_n of these polyepoxide compounds can have values up to approximately 9000; in general, however, they are in the range of approximately 150–4000.

[0014]

These polyepoxide compounds are, for example, dihydric alcohols, phenols, or polyglycidyl ethers based on hydrogen addition products of these phenols and/or novolacs (products obtained by reacting monohydric or polyhydric phenols, e.g., phenol and/or cresols with aldehydes, especially formaldehyde, in the presence of an acidic catalyst); they are obtained, for example, by customary methods, by reacting the polyols with epichlorohydrin.

[0015]

Examples of the polyhydric phenols mentioned here include resorcinol, hydroquinone, 2,2-bis(4-hydroxyphenylpropane (bisphenol A), isomer mixtures of[1] dihydroxydiphenylmethane (bisphenol F), 4,4'-dihydroxyphenylcyclohexane, 4,4'-dihydroxy-3,3'-dimethyldiphenylpropane, 4,4-dihydroxybiphenyl, 4,4'-dihydroxybenzophenone, 1,1-bis(4-hydroxyphenyl)ethane, 1,1'-bis(4-hydroxyphenyl)isobutene, 2,2-bis(4-hydroxy-tert-butylphenyl)propane, bis(2-hydroxynaphthyl)methane, 1,5-dihydroxynaphthalene, tris(4-hydroxyphenyl)methane, and 1,1'-bis(4-hydroxyphenyl)ether. Among these compounds, bisphenol A and bisphenol F are preferable.

[0016]

Polyglycidyl ethers of aliphatic polyhydric alcohols are also suitable as polyepoxide compounds. Examples of such polyhydric alcohols are 1,4-butanediol, 1,6-hexanediol, polyalkyene glycol, glycerol, trimethylol propane, 2,2-bis(4-hydroxycyclohexyl)propane, and pentaerythritol.

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[1] *Because of the difference in word order between Japanese and English, the "isomer mixtures of" may apply to "resorcinol, hydroquinone, and 2,2-bis(4-hydroxyphenylpropane (bisphenol A)" as well as the "dihydroxydiphenylmethane (bisphenol F)" – Translator's note*

[0017]

Other suitable polyepoxide compounds are (poly)glycidyl esters obtained by reacting epichlorohydrin or similar epoxy compounds with aliphatic, alicyclic, or aromatic polycarboxylic acids, e.g., oxalic acid, adipic acid, glutaric acid, phthalic acid, isophthalic acid, terephthalic acid, tetrahydrophthalic acid, hexahydrophthalic acid, 2,6-naphthalene dicarboxylic acid, or aliphatic acid dimers. Examples of such esters are diglycidyl terephthalate and diglycidyl hexahydrophthalate.

[0018]

Polyepoxide compounds which can be produced by emulsion copolymerization using olefinic unsaturated compounds containing randomly distributed epoxide groups in their molecular chains, for example, glycidyl esters of acrylic acid or methacrylic acid, can be used advantageously in some cases. Examples of other polepoxide compounds which can be used are ones based on heterocyclic rings, such as hydantoin-epoxy resins, triglycidyl isocyanate and/or its oligomers, triglycidyl-p-aminophenol, triglycidyl-p-aminodiphenyl ether, tetraglycidyl diaminodipenyl methane, tyetraglycidyl diaminodiphenyl ether, tetrakis(4-glycidyloxyphenyl)ethane, urazole epoxide, uracil epoxide, and oxazolidinone-modified epoxy resins. Other suitable compounds are aromatic amines, e.g., polyepoxides based on aniline, e.g., N,N-diglycidylaniline, diaminodiphenylmethane, and N,N'-dimethylaminodiphenylmethane or N,N'-dimethylaminodiphenylsulfone. Other suitable polyepoxide compounds are mentioned in the following literature (therefore, these references are listed as sources of information on them): *Handbook of Epoxy Resins*, Henry Lee and Kris Neville, McGraw-Hill Book Co., 1967; the research paper "Epoxy Resins" by Henry Lee, American Chemical Society, 1970; *Lackkunstharze*, Wanger/Sarx, Carl Hanser Verlag (1971), 5th edition, pp. 174ff.; *Angew. Makromol. Chemie* 44 (1975), pp. 151–163; German Patent Application Disclosure No. 27 57 733, Specifications; and European Patent Application Disclosure No. 0 384 939, Specifications.

[0019]

Polyepoxide compounds which are preferable for use are bisphenol A, bisphenol F, and bisphenol S (reaction products of these bisphenols and epichloro(halo)hidrin(s)) or bisglycidyl ethers based on them, polygycidyl ethers of phenol/formaldehyde- and/or cresol/formaldehyde-novolac, and diglycidyl esters of phthalic acid, isophthalic acid, tetraphthalic acid, tetrahydrophthalic acid and/or hexahydrophthalic acid and diglycidyl ester of trimellitic acid; N-glycidyl compounds of aromatic amine and heterocyclic nitrogen bases, e.g., N,N-diglycidylaniline, N,N,O-triglycidyl-p-aminophenol, triglycidylisocyanurate and N,N,N',N'-tetraglycidyl bis(p-aminophenyl)methane, hydantoin-epoxy resins and aracid-epoxy resins, and di- and polyglycidyl compounds of aliphatic polyhydric alcohols, e.g., 1,4-butanediol, trimethylol propane, and polyalkylene glycols. Such compounds are already publicly known (see *Angew. Makromol. Chem.* 44 (1975), pp. 151–163 and U.S. Patent No. 3,334,110 Specifications). Examples of them are products of bisphenol A diglycidyl ether reacted with diphenylmethane diisocyanate in the presence of a suitable accelerator. In the production of the coating material of this invention, these epoxy resins can be used individually or in mixtures.

[0020]

Suitable curing ingredients are aliphatic and aromatic polyamines. Aromatic polyamines are referred to, for example, in the Specifications of European Patent Application 0 274 646. They are produced by trimerizing 2,6- or 2,4-diisocyanate alkyl benzene and then hydrolyzing the remaining isocyanate groups. Such curing ingredients can be used individually or in mixtures. These mixtures are useful in industrial-scale production and make possible highly cost-effective production of the curing ingredients.

[0021]

As other additive curing agents (i.e., other ingredients besides the actual curing agents), one can use heterocyclic polyamines with urea groups. Other aromatic polyamines and/or other heterocyclic polyamines, such as 4,4-diaminodiphenylmethane and 4,4'-diaminodiphenylsulfone, can be used in curing agent mixtures in proportions of at most 30% by weight.

[0022]

The foam coating containing no halogents of this invention contain, preferably, 60–70% by weight epoxy resin and 30–40% by weight of the aforementioned flameproofing mixtures. Preferably, the coatings of this invention contain other additives, such as accelerants, fillers, pigments, softening agents, and/or reactive diluents. Suitable accelerants are, for example, imidazole derivatives, i.e., 2-methyllimidazole, 2-phenylimidazole, and 2-heptadecylimidazole; in addition to these, tertiary amines, such as phosphines and benzylmethylamines and tris(dimethylaminomethyl)phenol, as well as metal soaps and acetylacetonates, are also suitable.

[0023]

Examples of fillers are quartz, China clay, chalk, wollastonite, talc, aluminum oxide trihydrate, and antimony trioxide. Pigments which can be used include gas black, phthalocyanine pigments, and metal oxides. Softening agents which can be used in order to improve the resilience of the pigments include butadiene acrylonitrile rubber and other aliphatic polymers.

[0024]

Examples of suitable reactive diluents are low-molecular-weight unifunctional or multifunctional alcohols which react with epichlorohydrin. The epoxy groups used in the coating of this invention are ordinarily formed from epoxy resin ingredients and curing ingredients. Desirable epoxy resin ingredients are bisphenol A, bisphenol F, or mixtures of them; desirable curing ingredients are aliphatic amines.

[0025]

In like manner, a problem of this invention is to provide a method of producing flameproof foam coatings not containing halogens which contain epoxy resins and the aforementioned flameproof mixtures. This is accomplished by the method described above, in which epoxy resins are reacted with flameproof mixtures and the products are converted to coatings by using curing agents. In this method, solvents and diluents can also be used, as needed. In this respect, non-protic polar solvents are desirable. Examples of these are N-methylpyrrolidone, dimethylformamide, and

ethers (such as diethyl ether, tetrahydrofuran, dioxane, ethyl glycol ethers of monoalcohols with linear or branched alkyl groups with 1–6 carbon atoms, propylene glycol ether, and butyl glycol ether).

[0026]

Examples of other solvents are ketones, e.g., acetone, methyl ethyl ketone, methyl isopropyl ketone, methyl isobutyl ketone, cyclo[he]xanone, etc. One can also use esters, e.g., ethyl acetate, butyl acetate, ethylene glycol acetate, and methoxypropyl acetate. Other suitable solvents are halogenated hydrocarbons and alicyclic and/or aromatic hydrocarbons. Among them, hexane, heptane, cyclohexane, toluene, and dixylene are preferable. These solvents can be used individually or as mixtures.

[0027]

The epoxy resins are preferably reacted with the flameproof mixtures and then the curing agents at temperatures of -10 to +200°C. This invention also concerns a method for using the aforementioned coatings to make films. The coatings of this invention are preferably used for coatings of floors, walls, or molded articles.

[0028]

The coatings of this invention show good flame retardancies and can be used in a simple fashion. Therefore, these coatings can be produced by a simple and highly cost-effective method. In the working examples below, flameproof coatings were produced and their efficacies were tested. The flameproof mixture used in this case was Hostaflam AP 750 (Hoechst AG). The insulating properties of products produced by using these coatings were tested according to DIN4102, Part 2 (1977), by using a small-scale test set up according to DIN4102, Part 8 (1986). On the other hand, the test of the surface quality was performed visually.

[0029]

Working Examples

Working Examples 1–8

The following substances were used in the working examples:

Hostaflam AP 462 (registered trademark) (Hoechst AG)

- This is a microcapsulized ammonium polyphosphate produced by the method described in European Patent No. 0 180 795 Specifications, using Hostaflam AP 422 (registered trademark) as a base. It contains approximately 10% by weight capsule material consisting of cured melamine/formaldehyde resin. Hostaflam AP 422 (registered trademark) (Hoechst AG) has the formula $(NH_4PO_3)_n$ (in which n is 20–1000, preferably 500–1000). It is an easily flowing powdered ammonium polyphosphate showing a low solubility in water. The proportion of the granules with sizes less than 45 μm is greater than 99%.

Hostaflam AP 750 (registered trademark) (Hoechst AG)

- This is a flameproof mixture not containing halogens, containing an aromatic carboxylic acid ester of tris(2-hydroxyethyl)isocyanurate as a synergist and a polymeric ammonium phosphate.

Apyral 2 (registered trademark) (VAW Vereinigte Aluminium Werke AG)

- This is an aluminum hydroxide grade produced by the Bayer process and modified by a special technique (see European Patent No. 0011 667).

Beckopox EP 140 (registered trademark) (Hoechst AG)

- This is a low-molecular-weight condensation product with bisphenol A and epichlorohydrin which has a density of 1.16 g/mL (25°C) and an epoxide equivalent of 180–192.

Beckopox-Spezialhärter EH 625 (registered trademark) (Hoechst AG)

- This is a modified aliphatic polyamine with an H-active equivalent of 73 and a dynamic viscosity of 800–1200 mPa·s (25°C).

Working Example 1

After 100 g Beckopox EP 140 and 100 g Hostaflam AP 750 (42%) were introduced successively into a stirring vessel and thoroughly mixed, this mixture was reacted with 40 g Beckopox EH 625. The coating obtained was applied to one side of a 28 x 28 cm steel panel (St 37) using a roller, with a phosphorus content of 8.7%. This coating was cured completely in one day, at room temperature; its thickness was 1.5 mm.

[0030]

The surface of this film was smooth and free from cracks. When a flameproof test of the panel was performed according to DIN 4102, a flame resistance value (Brandklass) of F30 was obtained.

Working Example 2

The coating was produced in the same way as Working Example 1 and applied to a thickness of 2.4 mm.

[0031]

The surface of this film was smooth and free from cracks. When a flameproof test of the panel was performed according to DIN 4102, a flame resistance value of F60 was obtained.

Working Example 3

The procedure of Working Example 1 was repeated, except that 120 g Beckopox EP 140, 72 g Hostaflam AP 750 (30%), and 48 g Beckopox EH 625 were used. This coating was applied to a steel panel to a thickness of 1.5 mm; the phosphorus content of this coating was 6.3%.

[0032]

As in Working Example 1, the surface of this film was smooth and free from cracks. When a flameproof test of the panel was performed according to DIN 4102, a flame resistance value of F30 was obtained.

Working Example 4

The coating was produced in the same manner as in Working Example 3, and applied to a steel panel at a thickness of 2.6 mm.

[0033]

The surface of this film was smooth and free from cracks. When a flameproof test of the panel was performed according to DIN 4102, a flame resistance value of F60 was obtained.

Working Example 5 (Comparison Example)

The procedure of Working Example 3 was followed in producing the coating, except that Hostaflam AP 462 was used instead of Hostaflam AP 750. This coating was applied to a steel panel at a thickness of 2 mm.

[0034]

The surface of this film was smooth and free from cracks. When a flameproof test of the panel was performed according to DIN 4102, a flame resistance value of F30 was obtained.

Working Example 6 (Comparison Example)

After 120 g Beckopox EP 140, 64 g Apyral 2, and 8 g Hostaflam AP 750 were introduced into a stirring vessel and thoroughly mixed; this mixture was reacted with 48 g Beckopox EH 625.

[0035]

The phosphorus content of this coating was 0.7%. This coating was applied to a steel panel at a thickness of 2.2 mm. The surface of this film was not at all as smooth as those obtained in the working examples above. A flame resistance value of F30 was not obtained with this film.

Working Example 7

The coating produced in Working Example 1 was applied to a steel panel at a thickness of approximately 7 mm.

[0036]

The surface of this film was smooth and free from cracks. When a flameproof test of the panel was performed according to DIN 4102, a flame resistance value of F60 was obtained.

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